

THE PRESENCE OF *ZEBRUS ZEBRUS* (RISSE, 1826) (GOBIIDAE) ON THE ATLANTIC COAST OF SPAIN

by

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ABSTRACT. - The gobiid teleost *Zebrus zebrus* (Risso, 1826), formerly believed to be restricted to the Mediterranean Sea, has been found for the first time in the Atlantic, on the SW coast of Spain. More than a thousand specimens sampled over almost four years have revealed the preference of *Zebrus zebrus* for the intertidal pools. The number of specimens in each pool was in direct relation with the volume of the pool. This species has been abundant through all the year in some localities.

RÉSUMÉ. - Le gobie *Zebrus zebrus* (Risso, 1826) que l'on croyait limité à la Méditerranée a été localisé pour la première fois sur la côte Atlantique, au sud-ouest de l'Espagne. Les mille exemplaires trouvés pendant presque quatre années d'échantillonnage mettent en évidence la prédilection de *Zebrus zebrus* pour les mares de marée basse. Le nombre d'exemplaires trouvés dans une mare est proportionnel au volume de la mare. Dans quelques localités *Zebrus zebrus* a été abondant pendant toute l'année.

Key-words. - Gobiidae, *Zebrus zebrus*, ANE, Spain, Geographical distribution, Ecology.

Zebrus zebrus, the sole species of the genus, has been thought to be restricted to the Mediterranean Sea, where it has been found at only a few sites (Tortonese, 1975; Miller, 1977, 1986). Miller (1977) noted the possibility that *Zebrus zebrus* might extend into the Atlantic, while Ahnelt (1990) considered it a species difficult to find, though not rare, with unknown biology and behaviour.

Sampling of the fish in the intertidal zone of different sites of the Atlantic coast of Andalusia has demonstrated the presence of *Zebrus zebrus* in the Atlantic for the first time. It has also revealed certain aspects of the biology of this species, deduced from periodic sampling over almost four years.

MATERIALS AND METHODS

The rocky intertidal zone was sampled at 20 sites on the Atlantic coast of Andalusia on 136 days of spring tide between September 1986 and June 1990.

The fish were captured manually, with hand nets, or, in those cases where there were isolated pools among the rocks, the water was emptied using a pump (1 H.P.) and all the fish were collected. The volume of the pools fished ranged from 0.29 to 7.4 m³. The fish were measured live after anaesthetizing with ethylene glycol monophenyl ether dissolved in seawater (0.25:1000).

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RESULTS AND DISCUSSION

Distribution

Zebrus zebrus was found in only 6 of the 20 sites sampled on the Atlantic coast of Andalusia (Fig. 1). These sites were: El Portil, Punta del Perro, Punta de Santa Catalina del Puerto, Punta del Sur, Playa del Chato and La Barrosa, and as such are the first Atlantic sites where this species has been detected.

Until now, the only references to *Zebrus zebrus* have been on the Mediterranean coast (Tortonese, 1975; Miller, 1977, 1986; Ahnelt, 1990). The species was first found on the Spanish coast at Valencia (Rioja, 1920). Later, De Buen (1928) captured it in Majorca. Later still, Lozano (1960) studied specimens of *Zebrus zebrus* from Majorca, Mahón and Valencia, and lastly, Ramos (1985) mentioned its presence in the waters of Plana Island off the coast of Alicante. This work reports the first specimens of this species found on the Atlantic coast. It widens the area of distribution of the species and of the genus to outside the Mediterranean. Miller (1977) noted the possibility of finding the species *Zebrus zebrus* at warm Atlantic sites, but his hypothesis has not been confirmed until this work.

Biometry

A total of 1,278 specimens of *Zebrus zebrus* were captured, of which 55 were chosen at random for a full biometrical study. The rest were anaesthetized to measure their total length and then released at the capture site. The sex of this latter group was not determined. Of the 55 specimens retained, only 12 females and 18 males (a sex ratio significantly different to 1:1, $\chi^2 = 12.018$, $p < 0.001$)

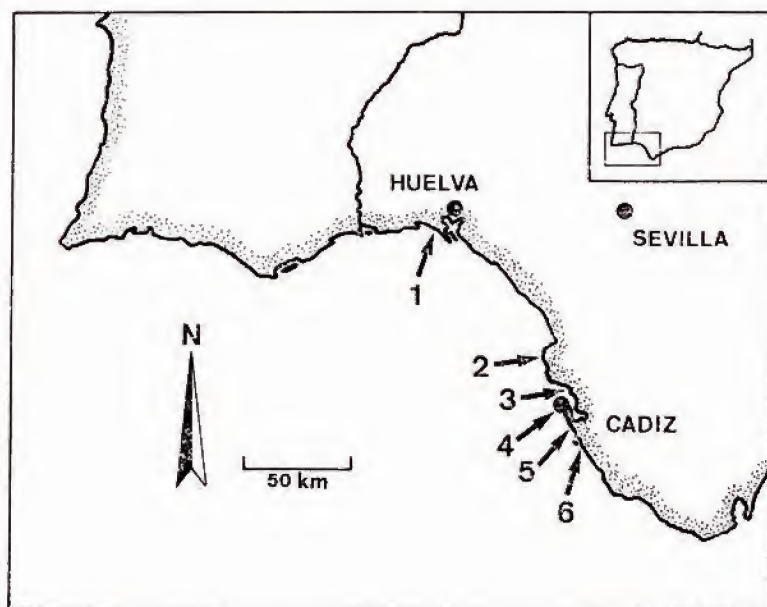


Fig. 1. - Sites of the Atlantic coast of Andalusia where *Zebrus zebrus* has been found. El Portil (1), Punta del Perro (2), Punta de Santa Catalina del Puerto (3), Punta del Sur (4), Playa del Chato (5) and La Barrosa (6).

could be sexed by the external form of the urogenital papilla (Miller, 1961). The rest were too small to determine the sex precisely.

The number of scales on the maximum longitudinal series of the 55 specimens analyzed ranged between 30 and 35, and the finray formulae were: D1: VI, D2: I+9-12, A: I+8-9 and P: 16-18. All these were within the ranges described by Tortonese (1975) and Miller (1977, 1986). The live colouring and the distribution of sensory papillae and canal-pores were also similar to those described by them. However, the range of total length that we found (12.00-61.00 mm) exceeded the maximum of 55 mm known until now (Carus, 1893 in Miller, 1977).

The size frequency histogram (Fig. 2) shows that some 80% of the intertidal population was between 20 mm and 40 mm in total length. The greatest total length found (61.0 mm) should be close to the maximum possible for this species.

No significant differences were found between the means of the dimensions or body ratios of the males and females (Table I). This contrasts with the findings of Miller (1977), which showed sexual differences in certain body ratios. The discrepancy may be due to the use of small samples. There were no biometric differences between the sample of Miller (1977) and ours, except in two aspects. The first was the ratio standard length/first dorsal fin base length in the males ($t = 10.550$; $p < 0.001$) and the females ($t = 8.560$; $p < 0.001$); and the second the ratio ocular diameter/interorbital distance in the males ($t = 2.699$; $p < 0.02$). The more noteworthy of these differences is the former, which is equivalent to 24.3% and 30.8% greater in the sample of Miller (1977). After re-examining our specimens and the scale drawings of Miller (1977), we reached the conclusion that the latter author must have considered the base length of the dorsal fin as the distance from the base of its first ray to the base of the last. However, we used the total base of the fin. That is, from the base of the first ray to the end of the posterior membrane of the fin. This different criterion in measuring the base of the first dorsal fin explains perfectly the discrepancy in the body ratio.

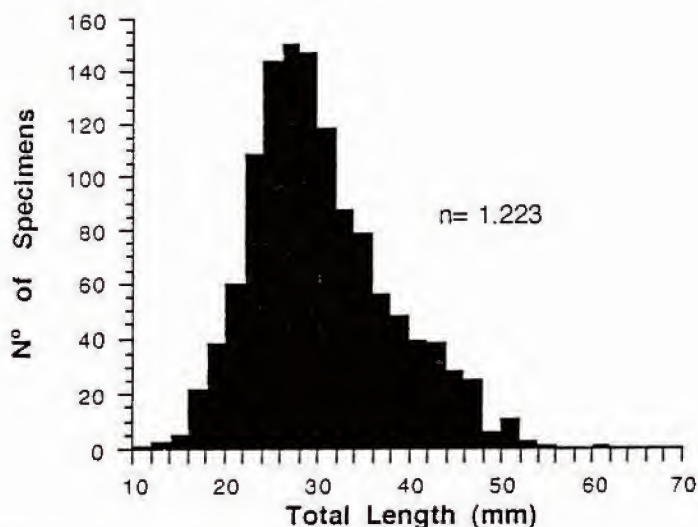


Fig. 2. - Histogram of size frequencies of *Zebrus zebrus*.

Table I. - Range and within brackets mean and standard error of the dimensions (in mm) and the body ratios of *Zebrus zebrus*.

	Males (n=18)	Females (n=12)	Total (n=55)
Total length (TL)	24.40-58.75 (38.62 ± 2.21)	33.80-48.80 (39.97 ± 1.25)	17.30-58.75 (33.28 ± 1.27)
Standard length (SL)	20.25-47.80 (31.21 ± 1.79)	27.00-39.00 (32.32 ± 1.04)	14.15-47.80 (27.00 ± 1.02)
Predorsal length (PDL)	7.00-16.00 (11.16 ± 0.60)	10.00-15.00 (11.65 ± 0.44)	5.00-16.00 (9.67 ± 0.36)
1st dorsal length (1stDL)	3.70-9.00 (5.73 ± 0.35)	5.00-6.85 (6.08 ± 0.15)	3.00-9.00 (5.03 ± 0.19)
2nd dorsal length (2ndDL)	5.90-13.50 (9.03 ± 0.50)	7.45-10.90 (9.04 ± 0.32)	4.00-13.50 (7.80 ± 0.28)
Head length (HL)	6.00-12.70 (8.91 ± 0.46)	7.80-11.00 (9.21 ± 0.28)	4.25-12.70 (7.75 ± 0.27)
Body height (BH)	3.15-7.75 (5.14 ± 0.34)	4.00-6.60 (5.11 ± 0.24)	2.00-7.75 (4.34 ± 0.19)
Eye diameter (ED)	1.55-3.00 (2.14 ± 0.09)	2.00-2.85 (2.29 ± 0.07)	1.00-3.00 (1.94 ± 0.06)
Interorbital length (IL)	0.48-1.05 (0.72 ± 0.04)	0.48-0.86 (0.69 ± 0.03)	0.29-1.05 (0.62 ± 0.02)
Preventral length (PVL)	5.60-13.30 (8.97 ± 0.52)	7.60-11.45 (9.19 ± 0.35)	3.70-13.30 (7.66 ± 0.30)
Pelvic disc length (PL)	4.15-9.25 (6.59 ± 0.33)	6.00-8.00 (6.77 ± 0.18)	3.10-9.25 (5.84 ± 0.19)
HL/ED	3.43-4.87 (4.13 ± 0.09)	3.63-4.50 (4.03 ± 0.08)	3.00-5.00 (4.00 ± 0.05)
SL/BH	5.36-6.81 (6.15 ± 0.10)	5.49-7.82 (6.34 ± 0.19)	5.36-7.82 (6.30 ± 0.07)
SL/HL	3.25-3.86 (3.49 ± 0.04)	3.37-3.69 (3.51 ± 0.03)	3.04-3.86 (3.46 ± 0.02)
SL/PDL	2.58-2.99 (2.79 ± 0.03)	2.60-2.85 (2.78 ± 0.02)	2.58-3.12 (2.79 ± 0.02)
SL/PVL	3.12-4.03 (3.49 ± 0.05)	3.17-3.83 (3.53 ± 0.05)	3.12-4.03 (3.54 ± 0.03)
SL/1stDL	4.80-6.27 (5.49 ± 0.10)	4.68-6.04 (5.33 ± 0.15)	4.56-6.75 (5.40 ± 0.07)
SL/2ndDL	2.96-3.65 (3.45 ± 0.04)	3.23-3.94 (3.59 ± 0.06)	2.96-3.94 (3.45 ± 0.03)
SL/PL	4.16-5.47 (4.72 ± 0.08)	4.50-5.17 (4.77 ± 0.06)	3.74-5.47 (4.59 ± 0.05)
ED/IL	2.20-4.10 (3.05 ± 0.12)	2.33-4.71 (3.41 ± 0.19)	2.09-6.11 (3.23 ± 0.11)
TL alive (n=1.223)			12.00-61.00 (30.77 ± 0.22)

Biology and ecology

The size frequency distribution of the individuals captured each month (Fig. 3) gives indirect information on certain aspects of the reproductive biology of the species. The graphs show that the first demersal forms, with total lengths between 10 and 20 mm, appear in May and continue until January. This suggests, although the gonadal state of the specimens was not studied, that the reproductive period of this species on the Atlantic coast of Andalusia is very long compared with other species in other regions. Examples are those of *Pomatoschistus microps* and *Gobius paganellus*, which cover five and two months respectively (Miller, 1961, 1975). Assuming that the time from spawning until the larvae are demersal and appear in the intertidal zone is similar to that of other goby species -such as *Gobius paganellus*, which is some 45 days (Miller, 1961)- the spawning of *Zebrus zebrus* should begin approximately in the middle of March or beginning of April and continue until the beginning of November. This period takes in July, during which Sparta (1948) reported spawning -the only known data on the reproduction of *Zebrus zebrus*. A spawning period of some seven months, such as this species seems to have on the Atlantic coast of Andalusia, may indicate that the females spawn more than once a year. This is known in other species, such as *Gobius paganellus* (Miller, 1961).

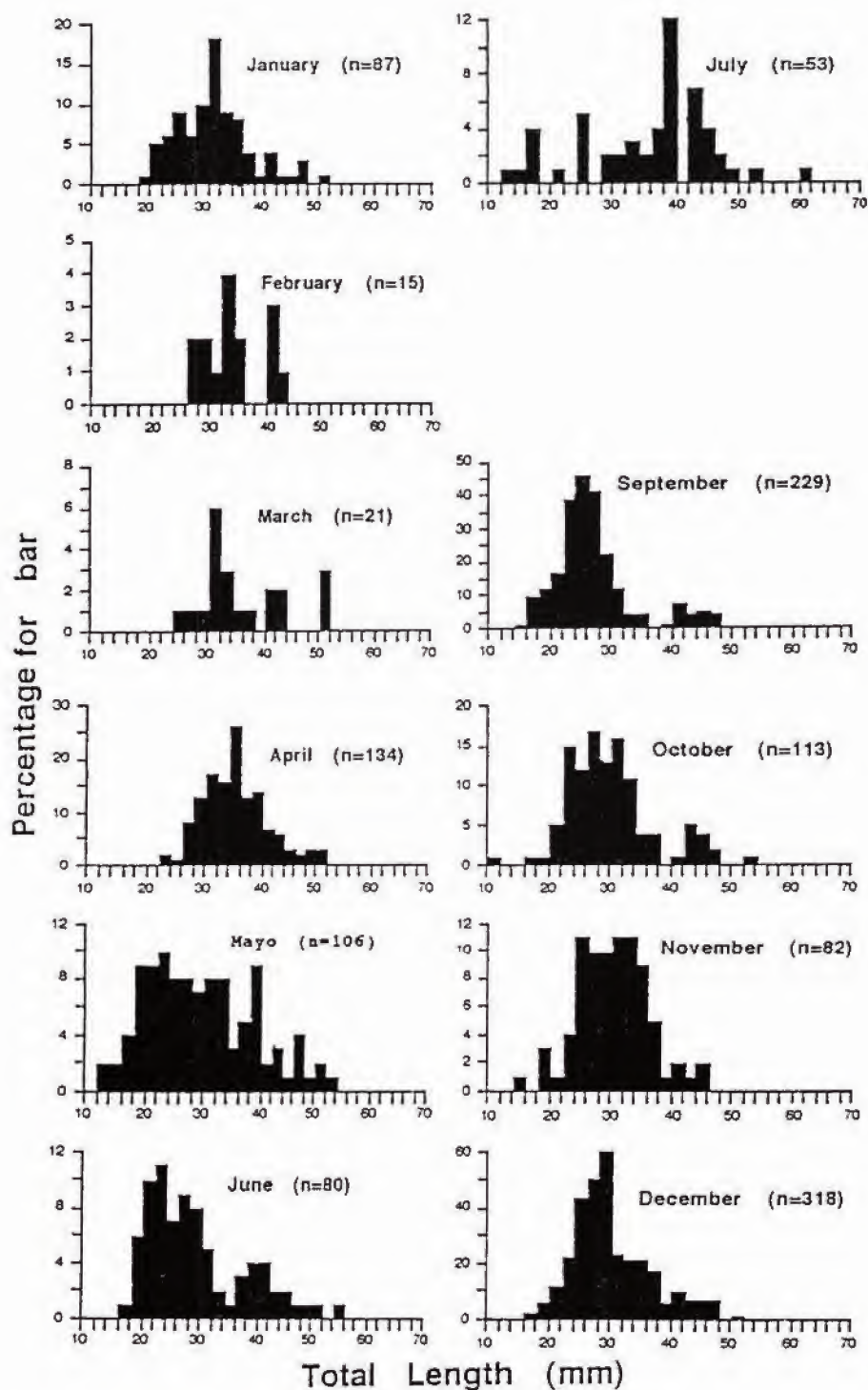


Fig. 3. - Histograms of size frequencies of *Zebrus zebrus* in different months.

There was an outstandingly high percentage (99.6%) of specimens of *Zebrus zebrus* found in pools isolated by the low tide, against the rest (0.4%) captured outside them under stones. We do not believe that either the search method or the small size of the species had much influence on the high percentage found in the pools. On one hand, *Zebrus zebrus* was not found in pools at some sites which were only 6 km. from other sites where the species was abundant, and on the other, there was no difficulty in finding similar-sized species outside the pools. Thus there was an obvious preference of *Zebrus zebrus* for the intertidal pools, although this does not appear to be the only factor determining its presence, given its absence in some sites with pools.

The high number of captures of *Zebrus zebrus* over the period also allowed us to estimate its density and abundance. Playa del Chato was the site of greatest abundance of *Zebrus zebrus*, with a mean annual number of 39.1 specimens per day of sampling (some 3 hours/day), against the 2.3 specimens per day of sampling in Punta de Santa Catalina del Puerto. In both cases, the method of capture was as described, performed by three persons. Much lower capture indices were found

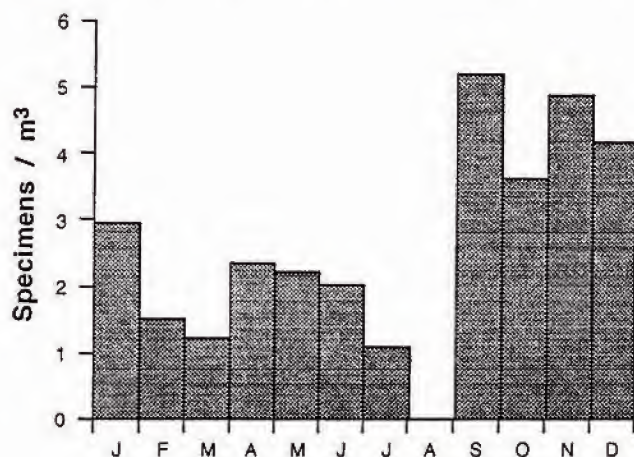


Fig. 4. - Mean monthly density of *Zebrus zebrus* in the pools of Playa del Chato.

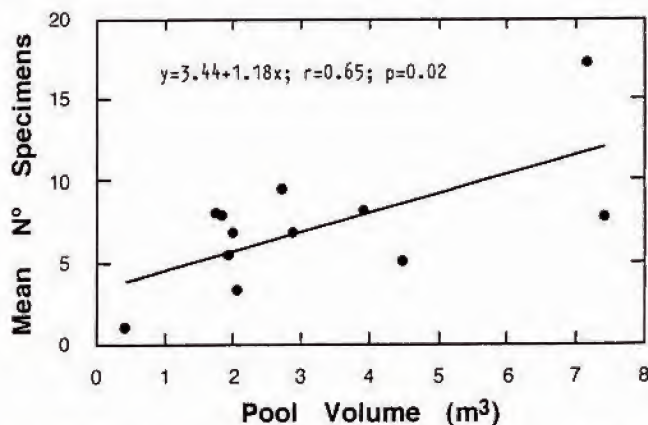


Fig. 5. - Ratio between pool volume and the mean number of specimens found, in Playa del Chato.

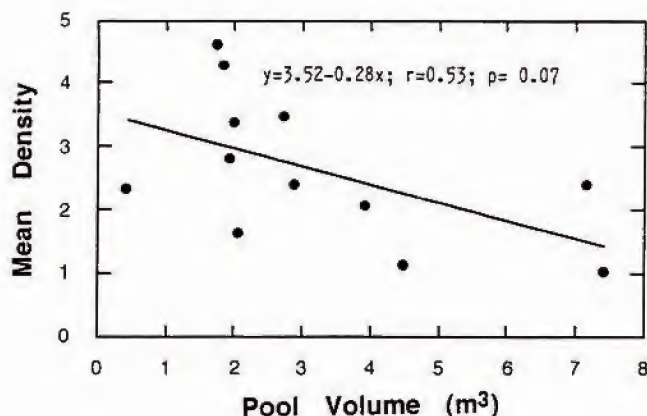


Fig. 6. - Ratio between pool volume and the mean density of fish found (specimens/m³), in Playa del Chato.

in the remaining sites. The mean annual density per pool volume in Playa del Chato was 2.9 specimens of *Zebrus zebrus* per m³ -highest (Fig. 4) between September and January- and 0.94 specimens/m³ in Punta de Santa Catalina del Puerto. The mean number of specimens in the pools increased with increasing volume of the pools (Fig. 5). However, the density appeared to decrease with increasing pool volume above around 2 m³ (Fig. 6).

Lastly, *Zebrus zebrus* was found in the pools together with one or various of the following species: *Gobius paganellus*, *Gobius cobitis*, *Gobius bucchichi*, *Coryphoblennius galerita*, *Lipophrys pholis*, *Lipophrys trigloides*, *Parablennius incognitus*, *Symphodus melops* and *Scorpaena porcus*. The presence or absence of *Zebrus zebrus* with the other species found in the pools did not show that *Zebrus zebrus* excluded or was excluded by any other species.

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